Microbial Characterization of Deep-Sea Hydrothermal Vent Plumes

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A principal focus of planetary protection research efforts at the Jet Propulsion Laboratory (JPL) is the development of cleaning and sterilization technologies for spacecraft preparation prior to launch. One aspect of such research entails the detection and characterization of microbes displaying unique survival capabilities in unfavorable environmental conditions. Characterization of novel microbes that possess various resistance capabilities can serve as a model from which new spacecraft cleaning and sterilization technologies may be developed.

The microbial diversity of samples taken from the Kali chimney, part of a deep-sea hydrothermal vent field in the Rodriguez Triple Junction, Indian Ocean (~2,240 m), was examined by both molecular and traditional, culture-based methods. Collectively, the microflora associated with these Indian Ocean deep-sea hydrothermal vent plumes define a previously uncharacterized extreme environment, and its description is next to non-existent in current literature. Based on *rrn* sequences retrieved from the chimney and its surrounding environment, novel, phylogenetically distinct microorganisms appear to be prevalent, but may be difficult to culture with present-day techniques.

Water, sediment, and animal samples were obtained directly from, as well as at variable distances (2-50 m) around the chimney to elucidate changes in the microbial profile. Following manual and automated DNA extractions, samples were subjected to eukaryal, archaeal, and eubacterially biased PCR conditions (SSU rDNA-targeted) and clone libraries were constructed. We were successful in retrieving archaeal sequences, and were able to identify about one-third of these to the species level. Sequences arising from methanogens, sulfate-reducers, and uncultured marine archaea were predominant. A total of 46 isolates were chosen for exposure to a number of environmental stresses, such as desiccation, 5% liquid H_2O_2, UV_{254}, and 0.5 Mrad γ-radiation. Varying levels of resistance to the above conditions were observed. The most intriguing was survival following a UV radiation dose of more than 1000 J/m^2.